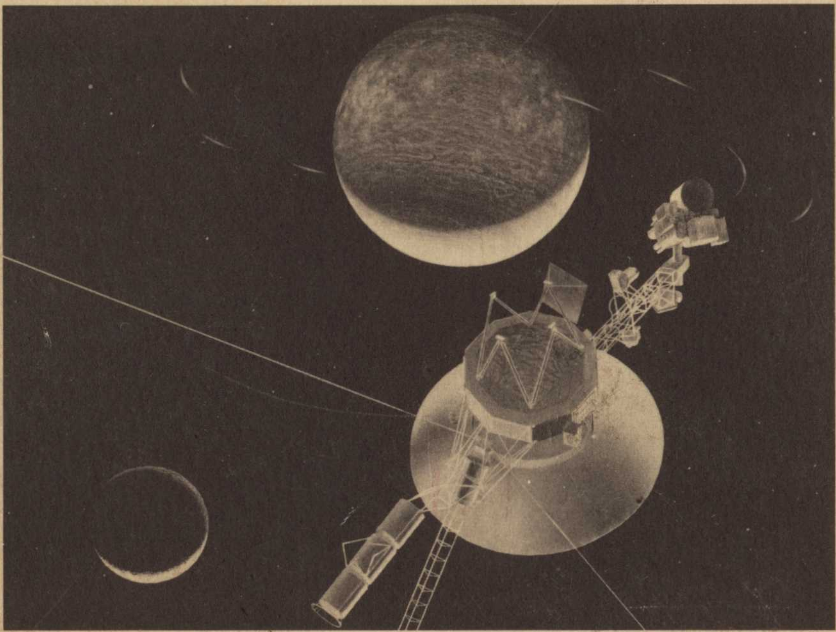
VOYAGER NEPTUNE TRAVEL GUIDE
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JPL Publication 89-24

The Voyager Neptune Travel Guide



June 1, 1989

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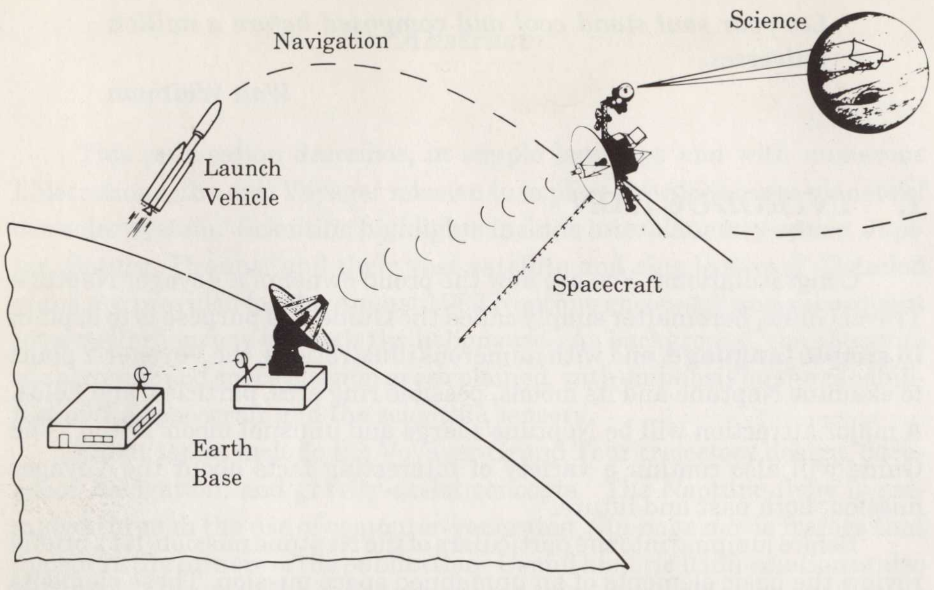


Figure 1-1. These are the five basic elements of an unmanned space mission. Earth Base is composed of a large complex of people, computers, communication lines, and tracking antennas. A manned space mission has a sixth element, the human crew for whom life support systems are required.

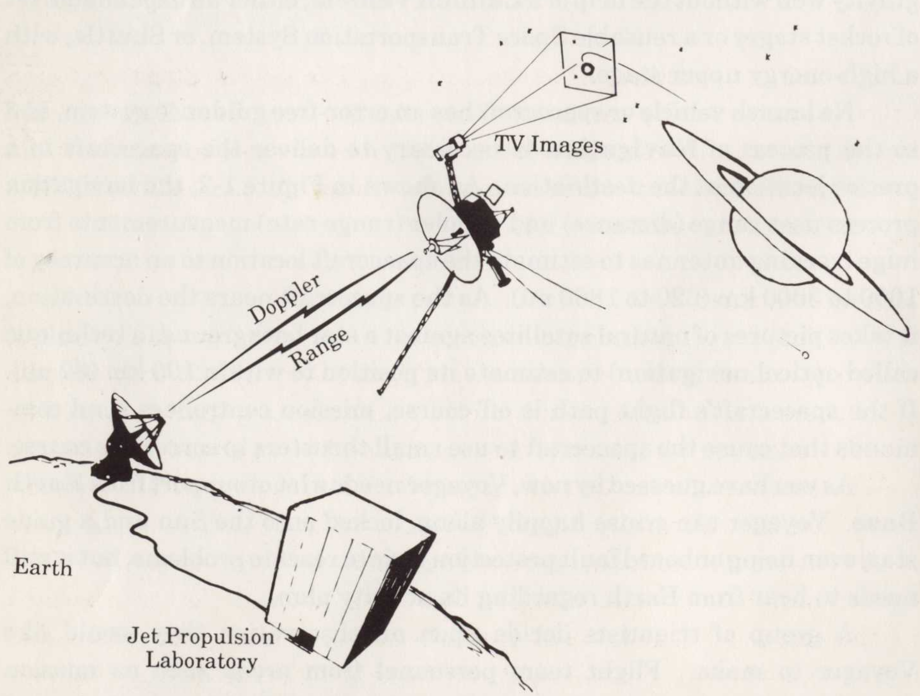


Figure 1-2. Navigators from Earth Base use radio tracking data and satellite-star images to estimate Voyager's position and heading.

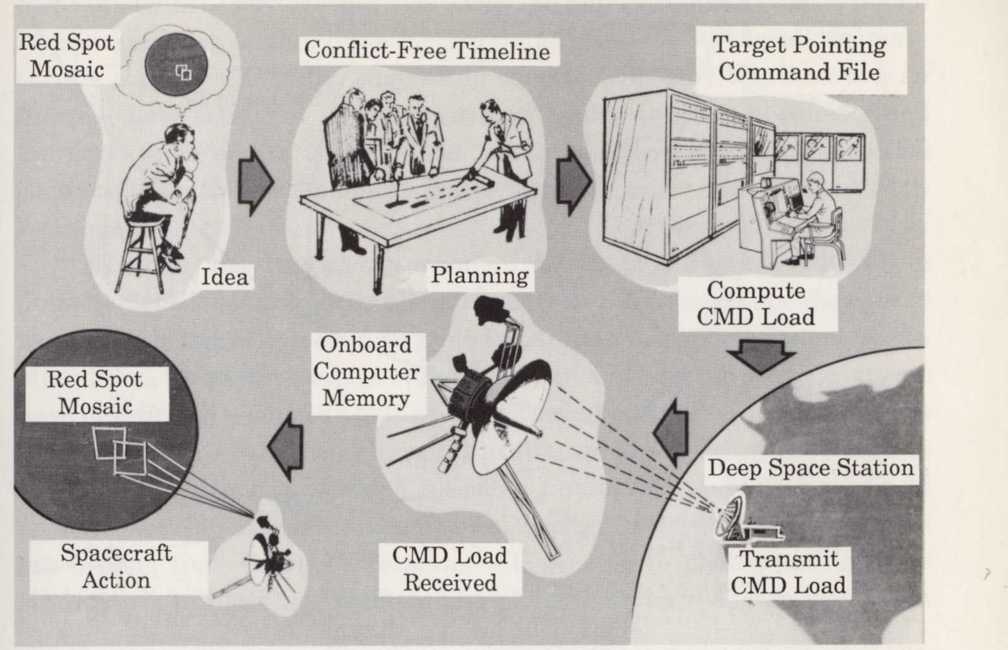


Figure 1-3. Many steps are necessary to develop activity sequences that Voyager will eventually execute.

master activity timeline. As shown in Figure 1-3, several steps are taken before Voyager finally carries out these instructions from Earth. Since Voyager has its own internal clock, desired activities can be loaded into its computers many days before they are to be executed. Each set of activities is termed a command load.

Voyager's Past

The Voyager mission has had quite a past. As shown in Figure 1-4, the two spacefaring robots were launched from Earth in 1977, bound for the giant planets of the outer solar system. These amazing machines are like distant extensions of the human sensory organs, having already exposed the once-secret lives of some four dozen worlds. Like remote tourists in never-never land, they have snapped pictures to reveal Saturn's dazzling necklace of 10,000 strands. Millions of ice particles and car-sized bergs race along each of the million-kilometer-long strands, with the traffic flow orchestrated by the combined gravitational tugs of Saturn, a retinue of moons and moonlets, and even the mutual interactions among neighboring ring particles.

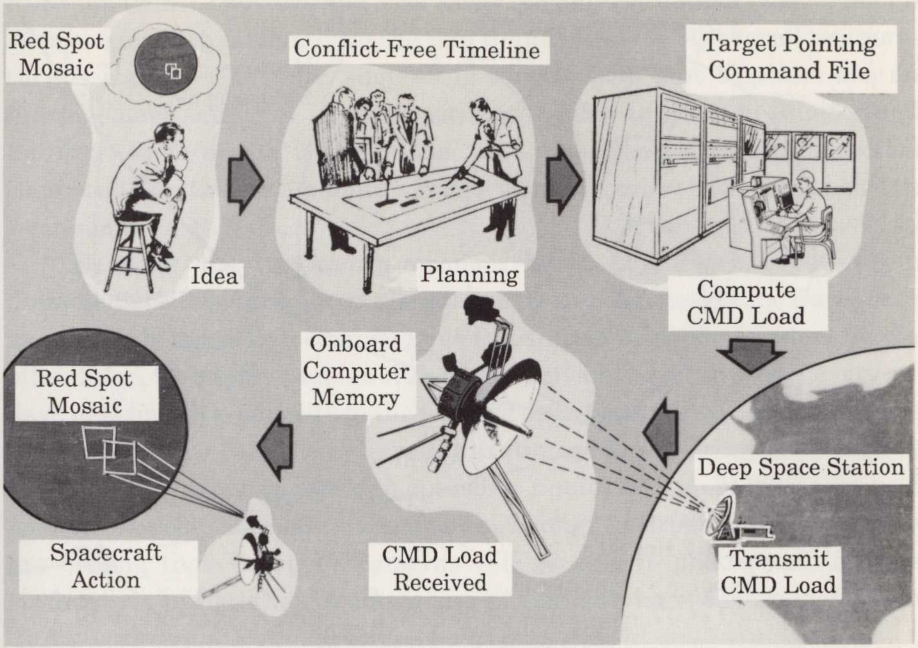


Figure 1-3. Many steps are necessary to develop activity sequences that Voyager will eventually execute.

Benny Macias Pena

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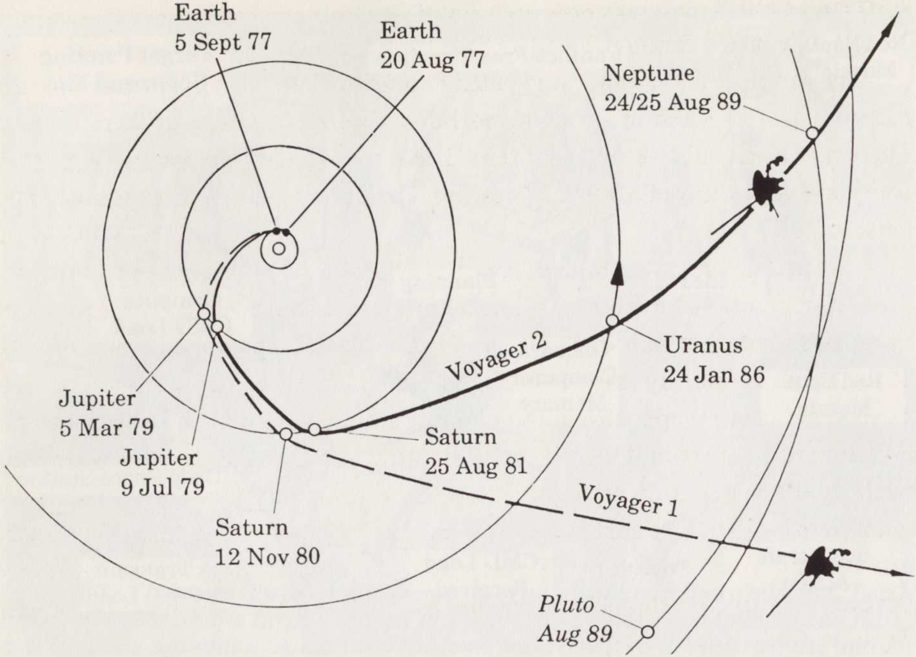


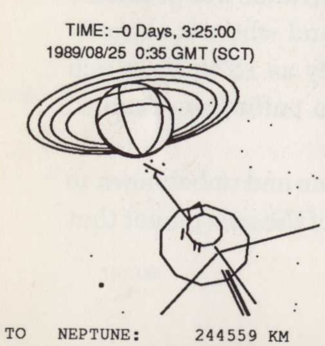
Figure 1-4. Though not discernible in this view, Voyager 1 was deflected upwards by its pass beneath Saturn. Voyager 2 remains near the ecliptic plane until its dive over Neptune deflects its path sharply downward, below the ecliptic plane. Accelerated by gravity assist, both Voyagers will cross the orbits of the outermost known planets by the turn of the decade, racing onward to escape from the solar system.

The Voyagers have shown us the erupting volcanoes of golden Io, the



Figure 2-1. Probably the first person to suggest that the irregularities in Uranus' orbit were caused by a new, more distant planet was the German mathematician Friedrich Wilhelm Bessel. *(A.H. Batten. Resolute and Undertaking Characters: The Lives of Wilhelm and Otto Struve. 1988. Permission granted by Kluwer Academic Publishers, Dordrecht, Holland.)*

must be pulling on Uranus. In England, John Couch Adams completed the calculations first, in 1845. He privately informed the English Astronomer Royal, George Airy, that if one was to look in a certain place at a certain time one would discover a new planet. Airy chose to disregard the prediction and did not make the observation. Subsequently, Airy did send Adams' calculations to James Challis, Plumian professor of astronomy and director of the Cambridge Observatory. Ironically, Challis recorded the new



planet twice without realizing his success. Along this vein, more than fifty years earlier, Joseph Lalande recorded the new planet twice over three nights . . . but attributed the slightly different positions of this find to observational error!

Meanwhile, in France, Urbain Jean Joseph Le Verrier completed his own calculations the following year. He turned his results over to both Airy and the French Academy of Sciences in published form, with a prediction on where and when to look to discover the new planet. His prediction was within one degree of Adams' earlier independent prediction.

The same fate befell his work as befell Adams' results: no observers used the predictions to look for a new planet. Finally, almost in desperation,

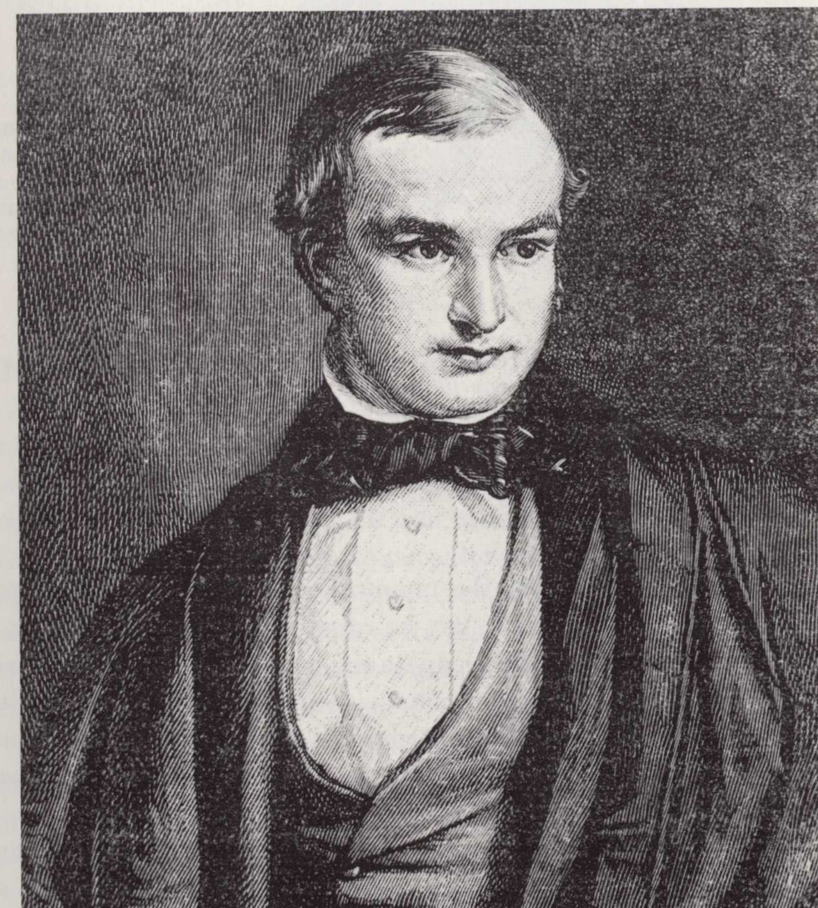


Figure 2-2. The first person to calculate the location of Neptune was the English mathematician John Couch Adams. Unfortunately, Adams did not publish his work right away, and the calculations of another were used to discover the new planet. *(Robert Ball. Great Astronomers. London, 1895.)*

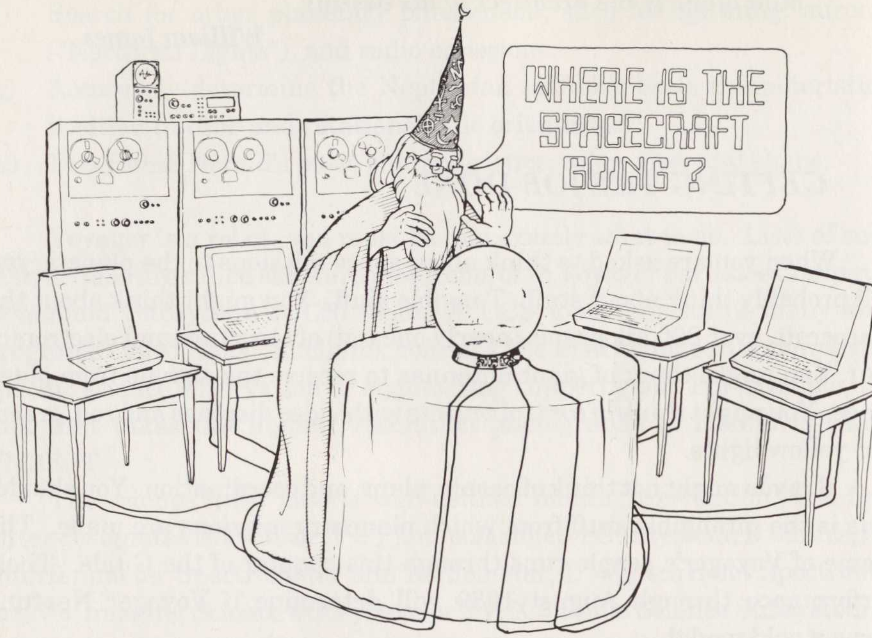


Figure 3-1. Charting Voyager's path through the solar system is a precise science, with only the occasional need to make artful choices among candidate "solutions."

Determining the locations of Triton and Nereid is initially the job of

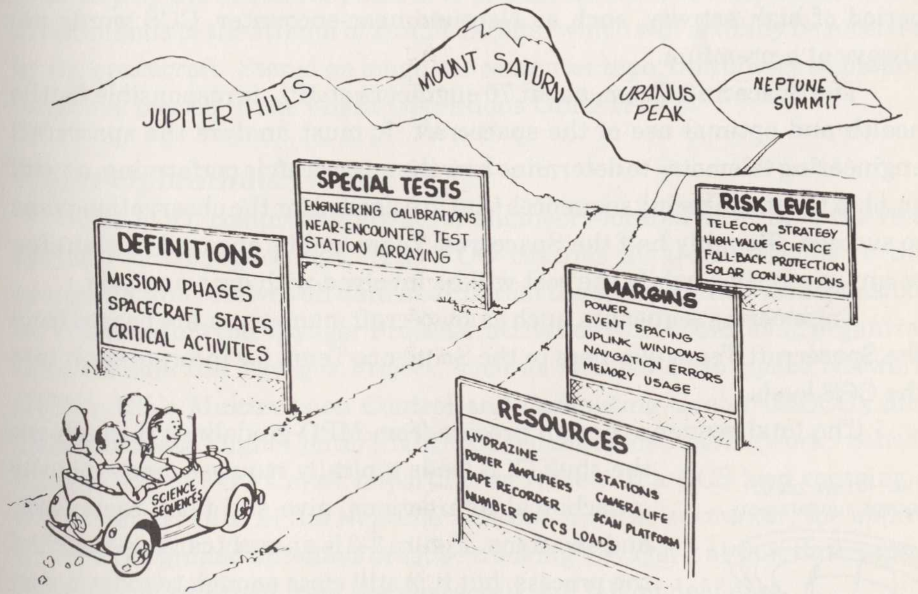


Figure 3-2. Mission planning establishes guidelines for the use of project consumables and helps define the envelope within which the sequences will be developed.



Figure 3-4. If we could move the 70-m DSN tracking antenna from its Goldstone, California, desert location to the football field inside the Pasadena Rose Bowl, this is how large it would appear! Big ears are needed at Earth Base to hear the feeble signals from a remote spacecraft.

seen at Earth until 8.2 hours after it was sent. Data telemetered from

4. THE VOYAGER SPACECRAFT

The mission objectives can be met only by delivering the spacecraft to the Neptunian system along the chosen flight path, properly orienting the spacecraft and pointing its instruments at the desired celestial bodies, powering the instruments, giving instructions to them, and channeling the science information gathered to the radio subsystem for transmission to Earth. In other words, a pretty complex machine is necessary to support the science instruments. Several years before launch, a spacecraft design team (Figure 4-1) worked out the basic requirements for this amazing machine and, judging by its success to date, they did a first-class job.

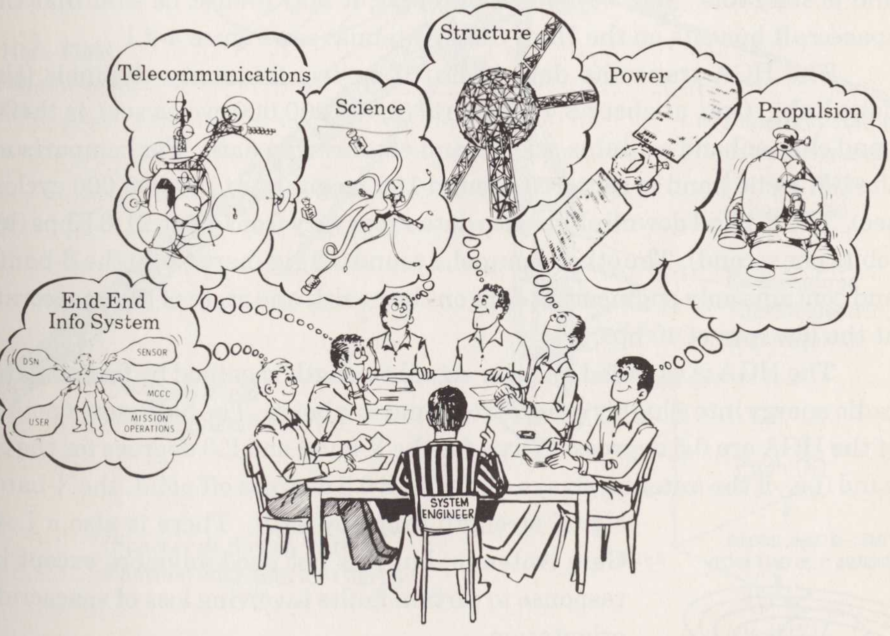


Figure 4-1. Before launch, a spacecraft design team did a lot of brainstorming to hammer out the dozens of major considerations (and thousands of smaller details) needed to design and build the amazing Voyager robots.

CCS Leads.

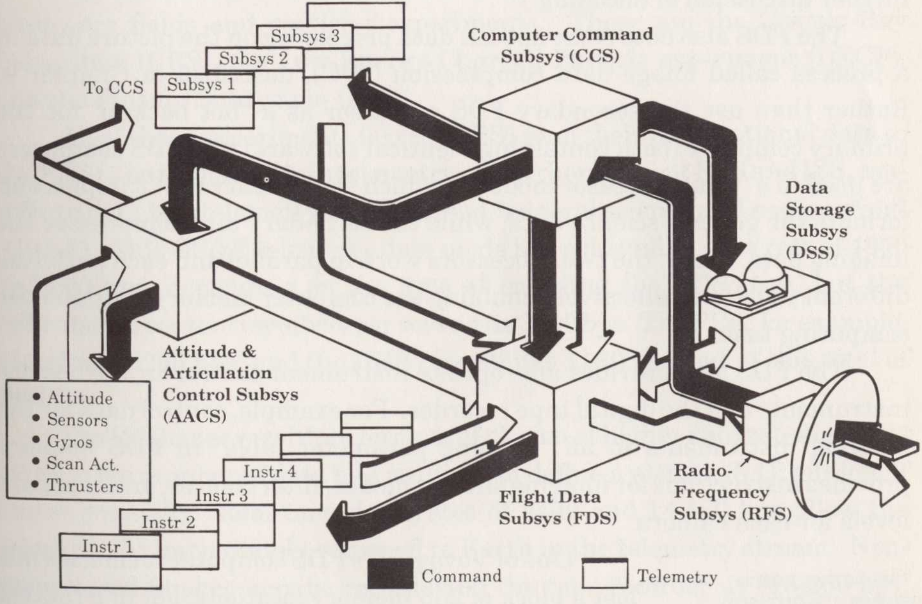


Figure 4-6. Voyager's three computer subsystems contain nearly 33,000 words of memory storage, with the Computer Command Subsystem (CCS) directing most of the activities.

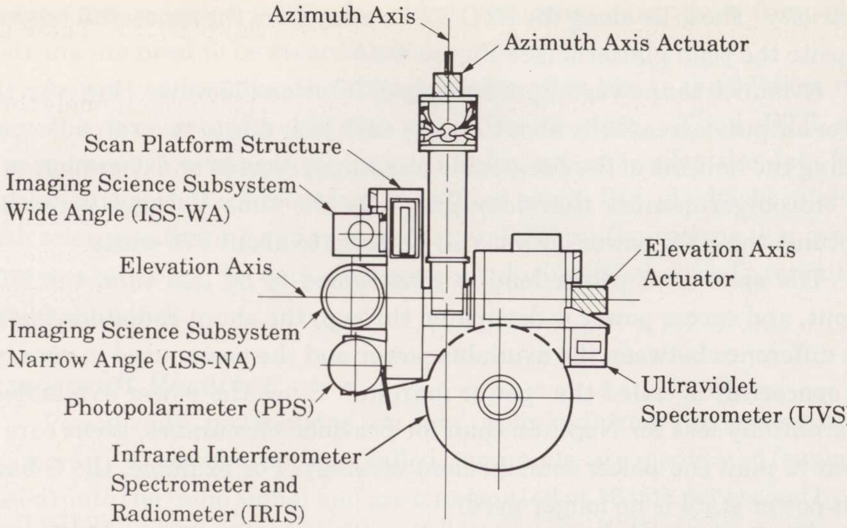


Figure 4-4. This view of the Voyager scan platform shows the locations of the two electric motors and gear trains, known as "actuators," that drive the platform to look in different directions.

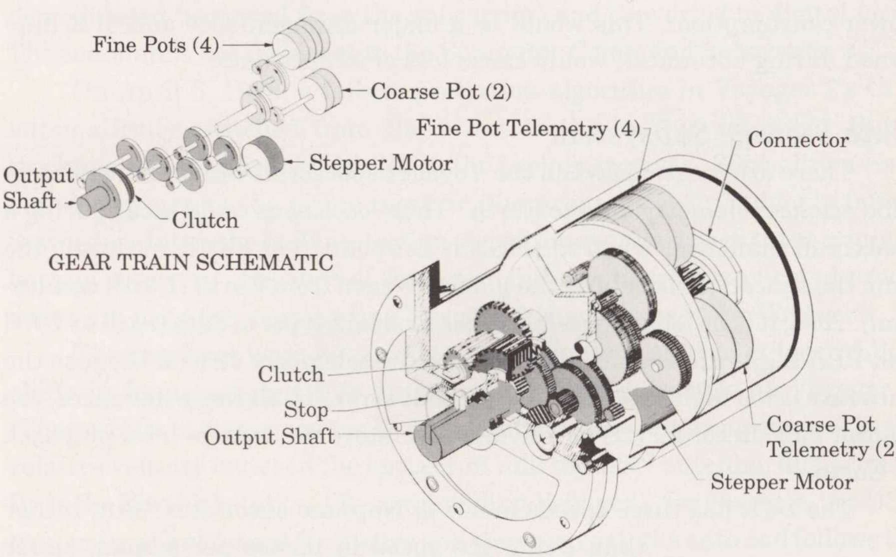


Figure 4-5. Small electric motors drive the Voyager scan platform about "azimuth" and "elevation" axes. Voyager 2's azimuth actuator stuck shortly after the Saturn encounter, but was used for the Uranus encounter and will be used for the Neptune encounter.

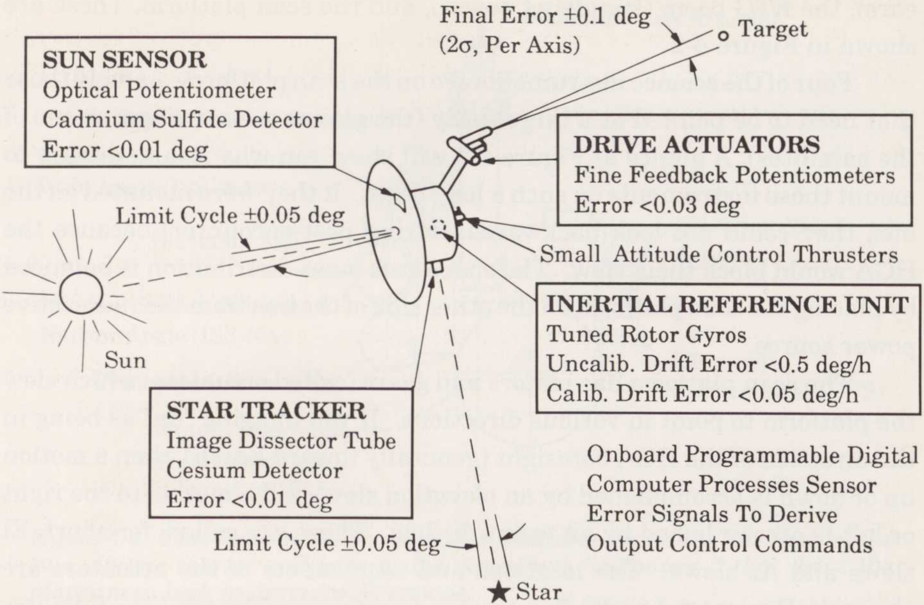


Figure 4-3. When it comes to pointing precision, the Voyager spacecraft is quite a remarkable machine.

(which is on the other side of the sky from Canopus) is chosen, and the Stellar

Bus

The basic structure of the spacecraft is called the "bus," which carries the various engineering subsystems and scientific instruments. It is like a large ten-sided box, which can be seen in Figure 4-2. The centerline of the bus is called the z-axis, or roll axis. The spacecraft will usually be aligned so this z-axis (and thus the High Gain Antenna) points to Earth. The spacecraft is designed to roll about this axis by firing small thrusters which are attached to the bus. The thrusters are fueled by a liquid called hydrazine.

Each of the ten sides of the bus contains a compartment (a bay) that houses various electronic assemblies. Bay 1, for example, contains the radio transmitters. The bays are numbered from 1 to 10 (numbered clockwise as seen from Earth).

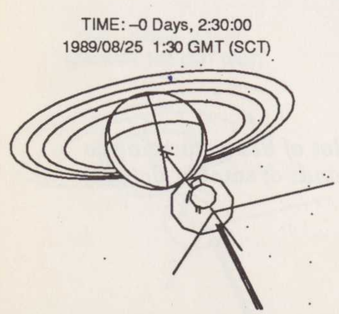
Two additional turn axes, at right angles to the roll axis and to each other, are needed to give the spacecraft full maneuverability. These are the x-axis (pitch) and the y-axis (yaw). The booms supporting the nuclear power sources and the scan platform lie along the y-axis.

High Gain Antenna (HGA)

On many spacecraft, a small antenna dish sits on the spacecraft bus and is steerable. But Voyager is different; it may almost be said that the spacecraft bus sits on the High Gain Antenna (see Figure 4-2.)

The HGA transmits data to Earth on two frequency channels (the downlink). One, at about 8.4 gigahertz (8,400,000,000 cycles/sec), is the X-band channel and contains science and engineering data. For comparison, the FM radio band is centered around 100 megahertz (100,000,000 cycles/sec). The X-band downlink science data rates vary from 4.8 to 21.6 Kbps (kilobits per second). The other channel, around 2.3 gigahertz, is in the S-band, and contains only engineering data on the health and state of the spacecraft at the low rate of 40 bps.

The HGA is so called because signal strength is gained by focusing the radio energy into a highly concentrated narrow beam. The half-power points of the HGA are 0.5 degrees off axis for the X-band and 2.3 degrees for the S-band (i.e., if the antenna strays as much as 0.5 degrees off point, the X-band signal strength drops by half). There is also a Low Gain Antenna, but it is not used anymore except in response to certain faults involving loss of spacecraft orientation.



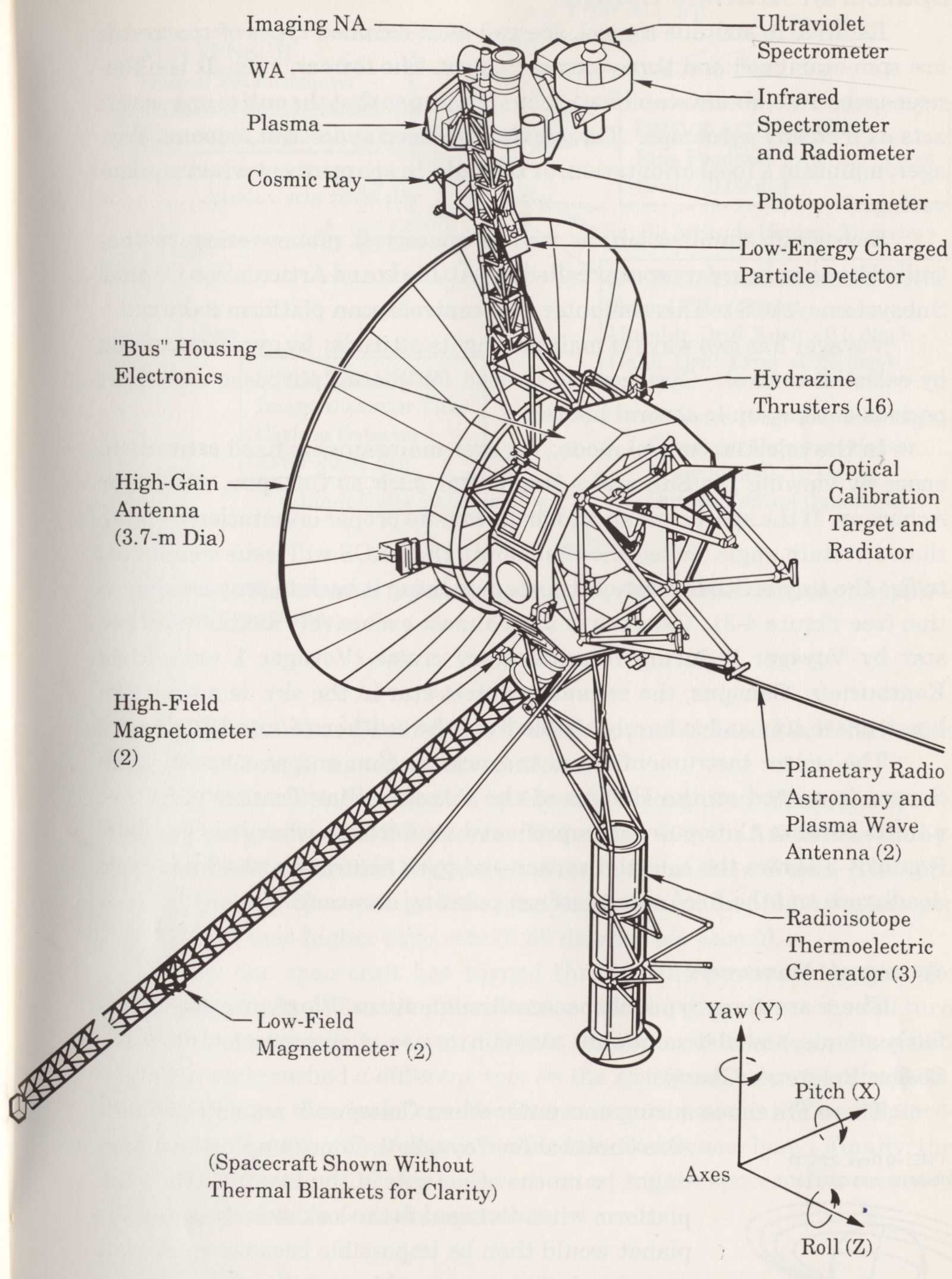


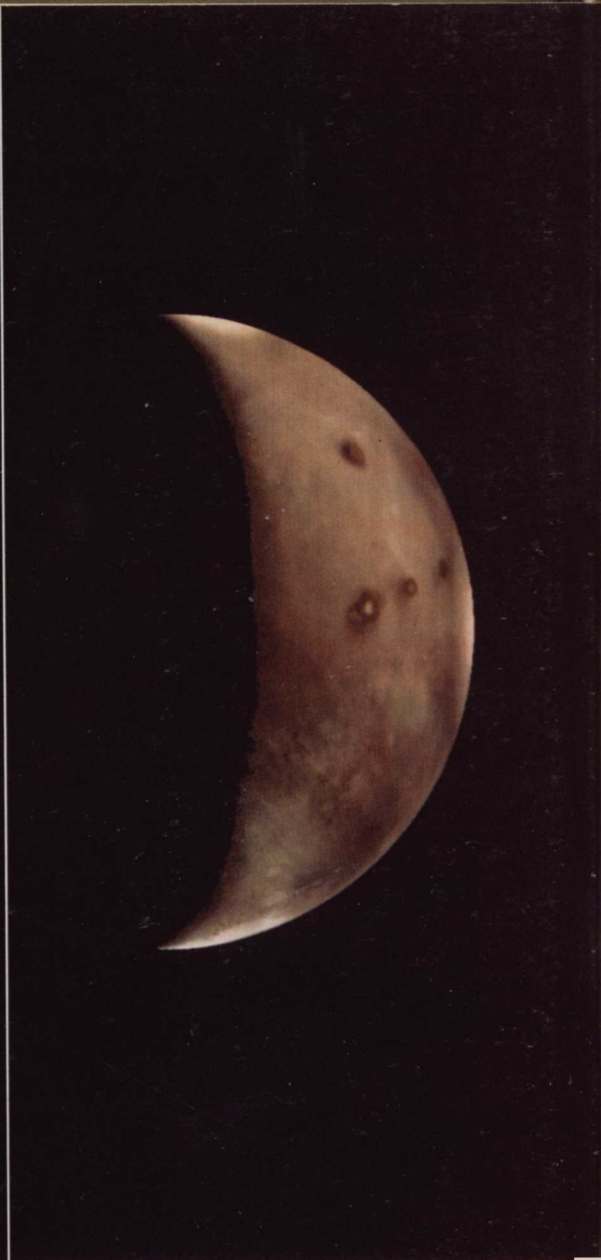
Figure 4-2. The Voyager spacecraft has a launch mass of 825 kg, is nuclear-electric powered, consists of about five million equivalent electronic parts, and uses onboard computer fault detection and response to protect itself.



VIKING ORBITER VIEWS OF MARS

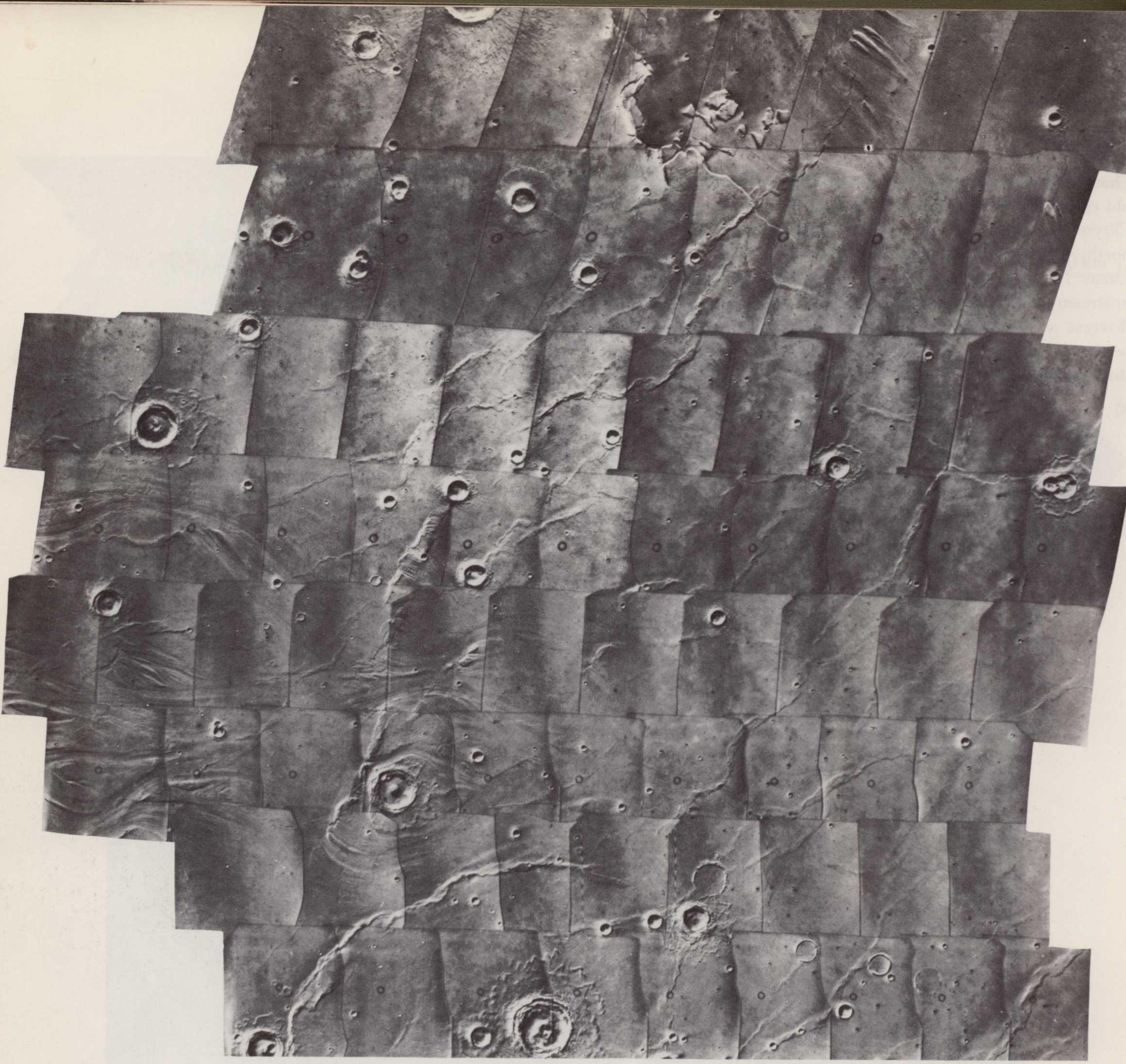
NASA



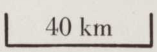


COMPARISON OF EARTH TO MARS

Earth		Mars
12 756 km	Diameter	6787 km
5.98×10^{24}kg	Mass	0.646×10^{24}kg
9.75 m/s^2	Gravitational acceleration	3.71 m/s^2
149.5×10^6 km (average)	Distance from Sun	227.8×10^6 km (average)
839 cal/cm^2/day	Sunlight intensity	371 cal/cm^2/sol
23° 27″	Inclination	23° 59′
24^h00^m	Length of day	24^h40^m (=1 sol)
365 days	Length of year	686 days (668 sols)
60 000γ	Magnetic field	50–100γ
1013 mb (average)	Atmospheric pressure	7 mb (average)
1	Known satellites	2







Western Chryse Planitia. The west side of Chryse Planitia has been extensively sculpted by flow from Maja Vallis, which is situated just to the left of this mosiac. Flow diverged across the gently sloping plain of Chryse Planitia to form the sculpted features seen in this mosiac. Ridges, similar to those on the lunar maria, appear to have partly dammed or diverted flow to form a variety of scour patterns. [211-5015; 21° N, 49° W]

Table 4. Asteroid Classification[a] and Diameters[b]

Asteroid	B(1,0)	D (km)	Type
1 Ceres	4.48	1018	U
2 Pallas	5.02	629	U
3 Juno	6.51	247	S
4 Vesta	4.31	548	U
5 Astraea	8.13	122	S
6 Hebe	6.98	195	S
7 Iris	6.84	210	S
8 Flora	7.73	153	S
9 Metis	7.78	153	S
10 Hygeia	6.50	450	C
11 Parthenope	7.80	151	S
12 Victoria	8.38	135	S
13 Egeria	8.15	241	C
14 Irene	7.49	153	S
15 Eunomia	6.42	245	S
16 Psyche	6.88	252	M
17 Thetis	9.08	96	S
18 Melpomonene	7.69	152	S
19 Fortuna	8.45	220	C
20 Massalia	7.73	137	S
21 Lutetia	8.61	111	M
22 Kalliope	7.28	178	M
23 Thalia	8.23	114	S
24 Themis	8.27	209*	C
25 Phocaea	9.30	65	S
26 Proserpina	8.80	90*	S
27 Euterpe	8.44	116	S
28 Bellona	8.16	122*	S
29 Amphitrite	7.13	194	S
30 Urania	8.82	90	S
31 Euphrosyne	7.28	332*	CM
32 Pomoma	8.76	93*	S
34 Circe	9.59	113*	C
36 Atalante	9.82	103*	C
37 Fides	8.43	93	S
39 Laetitia	7.44	164	S
40 Harmonia	8.32	121	S
41 Daphne	8.23	176	C
42 Isis	8.81	96	S
43 Ariadne	9.19	76*	S
44 Nysa	7.85	72	E
45 Eugenia	8.31	227	C
46 Hestia	9.56	133	C
47 Aglaja	9.24	134*	C
48 Doris	7.99	147?	U
49 Pales	8.67	178*	C
51 Nemausa	8.68	158	U
52 Europa	7.62	289	C
53 Kalypso	9.97	96*	C
54 Alexandra	8.87	177	C
55 Pandora	8.71	172?	CMEU
56 Melete	9.49	143	C
57 Mnemosyne	8.41	108*	S
58 Concordia	9.92	96*	C
60 Echo	9.98	50	S
61 Danae	8.90	87*	S
62 Erato	9.85	103*	C
63 Ausonia	8.96	89	S
64 Angelina	8.84	56	E
65 Cybele	7.99	308	C
66 Maja	10.51	76*	C
67 Asia	9.66	61*	S
68 Leto	8.22	124	S
69 Hesperia	8.17	134?	U
70 Panopaea	8.93	154	C
71 Niobe	8.28	114*	S
72 Feronia	10.15	92*	C
76 Freia	9.11	143?	CMEU
77 Frigga	9.70	61*	M
78 Diana	9.17	139*	C
79 Eurynome	9.25	75	S
80 Sappho	9.22	86	U
81 Terpsichore	9.64	112*	C
82 Alkmene	9.52	64	S
83 Beatrix	9.76	106*	C
84 Klio	10.34	81	C
85 Io	8.92	146	U
86 Semele	9.71	107*	C
87 Sylvia	8.12	224?	CMEU
88 Thisbe	8.07	206	C
89 Julia	8.15	168	S
90 Antiope	9.41	124*	C
91 Aegina	10.00	105	C
92 Undina	7.95	150?	U
93 Minerva	8.71	167	C
94 Aurora	8.71	190	C
95 Arethusa	8.83	165*	C
97 Klotho	8.75	94	M
100 Hekate	9.08	79*	SU
102 Miriam	10.28	83*	C
103 Hera	8.84	89*	S
104 Klymene	9.44	121*	C
105 Artemis	9.42	124*	C
106 Dione	8.80	169*	C
107 Camilla	8.28	209*	C
108 Hecuba	9.69	60*	S
109 Felicitas	10.13	74	C
110 Lydia	8.75	169*	C
111 Ate	9.11	143*	C
113 Amalthea	9.86	47	S
114 Kassandra	9.46	121*	C
115 Thyra	8.84	93	S
116 Sirona	8.89	80	SR
117 Lomia	9.18	138?	CMEU
119 Althaea	9.82	57*	S
120 Lachesis	8.78	174	C
122 Gerda	9.16	139*	CU
123 Brunhild	10.13	49*	S

Table 4 (continued)

Asteroid	B(1,0)	D (km)	Type
124 Alkeste	9.39	67	S
125 Liberatrix	9.77	64?	U
126 Velleda	10.58	40*	S
129 Antigone	7.85	114	M
130 Elektra	8.46	121?	U
131 Vala	11.03	35	SM
133 Cyrene	9.18	78*	S
135 Hertha	9.24	78	M
137 Meliboea	9.14	142*	C
139 Juewa	9.16	139*	C
140 Siwa	9.58	102	C
141 Lumen	9.58	115*	C
144 Vibilia	9.15	132	C
145 Adeona	8.67	175*	C
146 Lucina	9.30	131*	C
148 Gallia	8.47	106*	S
149 Medusa	11.94	24?	U
150 Nuwa	9.33	129?	CMEU
151 Abundantia	10.53	41*	S
152 Atala	9.60	63*	S
153 Hilda	8.82	99?	U
156 Xanthippe	9.81	103*	C
159 Aemilia	9.32	133	C
162 Laurentia	10.01	97*	C
163 Erigone	10.80	65*	C
164 Eva	9.84	101*	C
166 Rhodope	10.91	38?	U
170 Maria	10.72	41?	U
172 Baucis	10.09	67	S
173 Ino	8.82	162*	C
176 Iduna	9.52	72?	U
177 Irma	10.75	67*	C
178 Belisana	10.69	38*	S
179 Klytaemnest	9.31	71*	S
181 Eucharis	9.06	79*	S
182 Elsa	10.24	47*	S
183 Istria	10.98	33*	S
185 Eunike	8.75	168*	C
186 Celuta	10.46	45	U
189 Phthia	10.76	41	S
192 Nausikaa	8.61	93	S
194 Prokne	8.84	193	C
195 Eurykleia	10.07	92*	C
196 Philomela	7.72	160	S
200 Dynamene	9.47	121?	CME
203 Pompeja	10.08	91*	C
204 Kallisto	10.07	50*	S
206 Hersilia	9.84	101*	C
208 Lacrimosa	10.48	42	S
209 Dido	9.47	121?	CMEU
210 Isabella	10.45	77*	C
211 Isolda	9.02	167	C
213 Lilaea	10.12	46?	EU
214 Aschera	10.41	43?	MU
216 Kleopatra	8.21	218?	CMEU
219 Thusnelda	10.68	38*	SM
221 Eos	8.94	97?	U
224 Oceana	9.79	59*	M
230 Athamantis	8.65	114	S
236 Honoria	9.51	65*	S
238 Hypatia	9.23	153	C
241 Germania	8.61	179*	C
247 Eukrate	9.31	143	C
250 Bettina	8.49	192?	CMEU
258 Tyche	9.54	65*	S
264 Libussa	9.67	63	S
268 Adorea	9.76	106*	C
270 Anahita	10.03	50	S
275 Sapientia	10.04	94*	C
276 Adelheid	9.74	106?	CMEU
281 Lucretia	13.11	15?	U
284 Amalia	11.28	52*	C
293 Brasilia	11.07	58*	C
295 Theresia	11.41	27*	S
306 Unitas	10.02	52*	S
308 Polyxo	9.28	136	U
313 Chaldaea	10.10	92*	C
324 Bamberga	8.07	251	C
326 Tamara	10.32	81*	C
335 Roberta	9.93	48?	EU
336 Lacadiera	10.96	33?	MEU
337 Devosa	9.90	99?	CS
338 Budrosa	9.78	58*	M
342 Endymion	11.29	52*	C
344 Desiderata	9.09	145*	C
345 Tercidina	10.15	89*	C
349 Dembowska	7.24	144	R
350 Ornamenta	9.45	122*	C
351 Yrsa	10.30	45*	S
354 Eleonora	7.48	169	U
356 Liguria	9.27	149	C
357 Ninina	9.82	104*	C
360 Carlova	9.42	129	C
362 Havnia	10.13	89*	C
363 Padua	10.05	94*	C
364 Isara	11.08	31?	SMR
365 Corduba	10.32	99	C
367 Amicitia	12.10	19*	S
370 Modestia	11.72	43*	C
377 Campania	10.04	95?	CMEU
381 Myrrha	9.68	126	C
384 Burdigala	10.81	36*	S
386 Siegena	8.60	174	C
387 Aguitania	8.45	112	S
388 Charybdis	9.52	119?	CMEU
389 Industria	9.40	69*	S
393 Lampetia	9.32	121	C
395 Delia	11.49	48*	C

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Asteroid	B(1,0)	D (km)	Type
1 Ceres	4.48	1018	U
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17 Thetis	9.08	96	S
18 Melpomonene	7.69	152	S
19 Fortuna	8.45	220	C
20 Massalia	7.73	137	S
21 Lutetia	8.61	111	M

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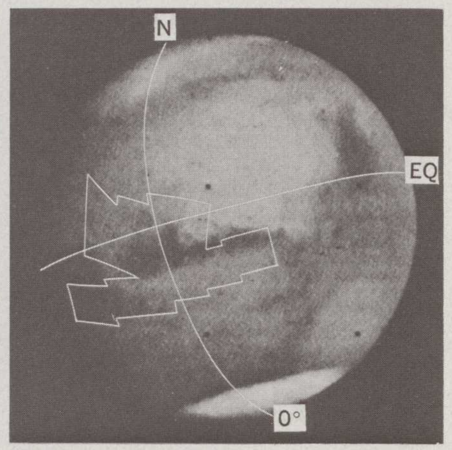
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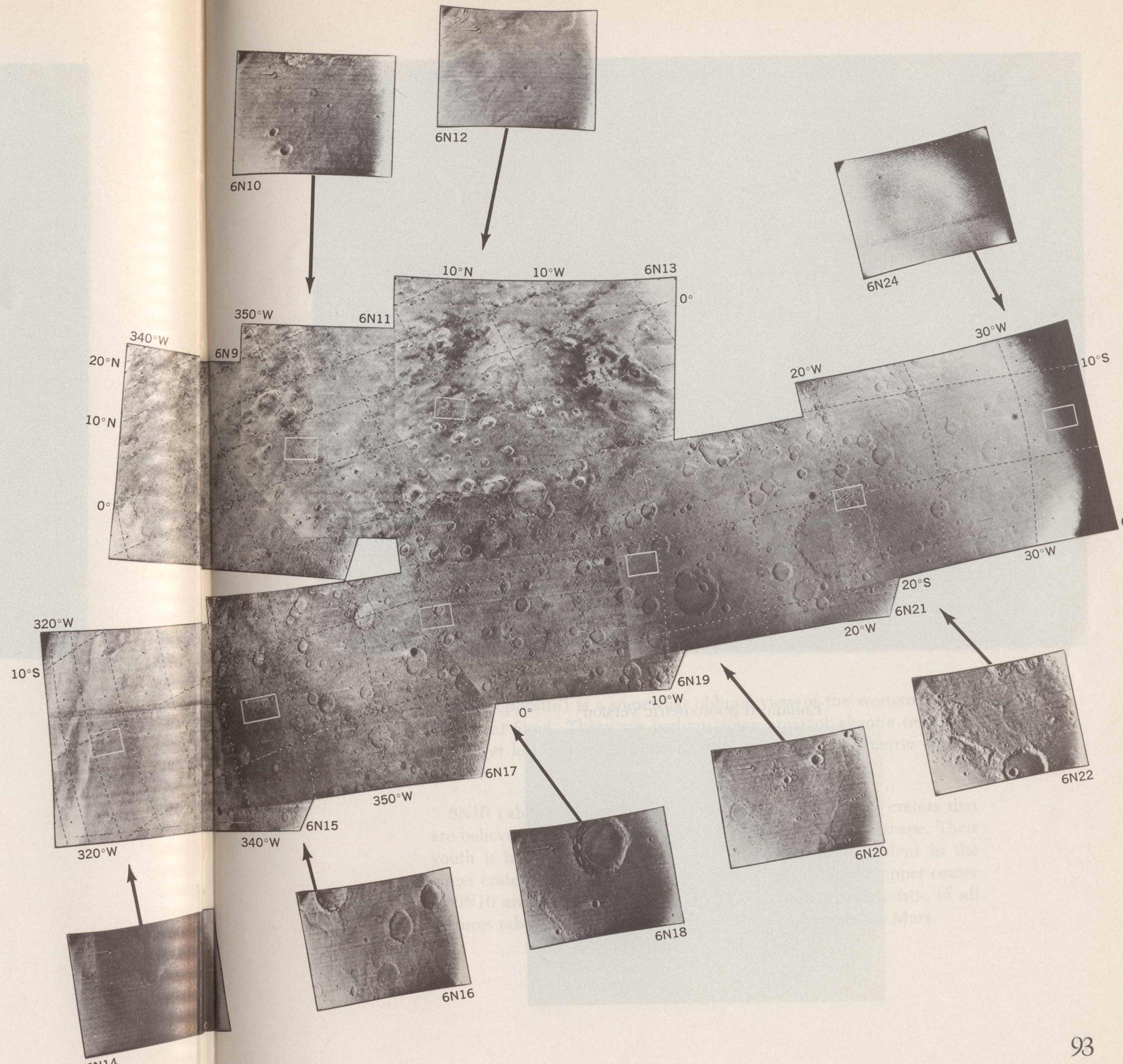


6N9-25, Meridiani Sinus

7F67

After recording 6N8, the Mariner 6 computer "slewed" the television cameras to point farther north and photograph the dark feature Meridiani Sinus. Later, after 6N13, a second slew directed the cameras southward again to study the boundary between the dark Sabaeus Sinus and lighter Deucalionis Regio. In far encounter, Meridiani Sinus and Sabaeus Sinus appeared as very well defined dark features extending to the west of Syrtis Major (7F67, 6F30). In trying to identify such albedo variations in these near encounter pictures, it is important to remember the on-board processing explained in Chapter 2, which served to minimize the visibility of such large albedo variations. Careful comparison of light and dark areas has not yielded any sure explanation of the difference between them. The tentative conclusion has been offered, however, that some light areas are areas of lower elevation onto which light dust has been transported, possibly by winds.

These 17 pictures also offer the most extensive and comprehensive coverage of Martian cratered terrain and thus lend themselves to comparison with pictures of the Earth's moon. Such analysis has revealed that, unlike the Moon, Mars has two distinct crater classes: small, young, bowl-shaped craters and larger, older, flat-bottomed craters, which have been strongly modified by unknown processes.



[90] *Dolphin* [*Lambert*] *18-Feb-84 6:16AM-PST*

The Hoagland hypothesis is surely a possibility, but it sounds a bit "Von Daniken" to me until we establish the city's existence beyond doubt. I agree that alignments with the polar axis, sunrise, etc. is good evidence to include and that archaeoastronomy on earth is a valuable new science.

Dolphin's reference to Von Daniken was a decisive intellectual upper hook to Hoagland's attempt to steer the conference. The reference here implies sensational speculation without a reasonable foundation. (Von Daniken was the author of the book *Chariots of the Gods*, which sought to explain many archaeological ruins on Earth as the work of travelers from outer space. Most scientists consider this type of approach to be invalid since there is only theory and conjecture without any substantial evidence.) During the course of the conference and later on several participants were confronted by their colleagues as "coming close to Von Daniken."

Meanwhile back at the "Face," the industrious John Brandenburg has found yet another image.

On February 21, John Brandenburg reported the arrival of print 673B56 from the United States Geological Survey (USGS). In this image, the face is smaller than in the high resolution pictures, but it remains visible (7-9 pixels across). The print he received was overexposed but the sun angle was close to that of 70A13 but slightly later and possibly more from the bottom of the picture. Brandenburg expects the data tape to provide more corroborative data to 70A13 regarding the dark side of the face and to provide data confirmng the pyramids and the Fortress. The photo offers good coverage of the entire area. Another photo of low resolution, 9162848 Mariner 9 (M9) A-Camera, also provides broad area coverage. Brandenburg notes that these pictures will be useful for cratering studies. The photo index for Mariner 9 had also arrived and he promised to confirm the presence or absence of high resolution photos taken by Mariner 9.

[95] ***Brandenburg*** [***John***] ***21-Feb-84 5:19PM-PST***

GOOD NEWS: PRINT OF 673B56 ARRIVED FROM USGS. FACE IMAGE IS SMALLER THAN HI RES SHOTS BUT CLEARLY VISIBLE WITH ESTIMATED 7-9 PIXELS ACROSS. UNFORTUNATELY PRINT OF FACE IS OVER EXPOSED BUT AM SENDING TO LAMBERT ASAP. SUN ANGLE IS ALMOST THE SAME AS 70A13 BUT SLIGHTLY LATER AND PERHAPS SLIGHTLY MORE FROM BOTTOM. THIS PHOTO WHEN TAPE IS OBTAINED (AS IT SHOULD DEFINITELY BE) SHOULD GIVE MUCH CORROBORATIVE DATA TO 70A13 AS TO DARK SIDE OF FACE AND ALSO SHOULD GIVE CONFIRMING DATA ON PYRAMIDS AND FORTRESS. I CONSIDER THIS A SUBSTANTIAL ADDITION TO OUR DATA BASE. ALSO PHOTO GIVES GOOD AREA COVERAGE ADDITIONAL PHOTO — VERY LOW RESOLUTION 9162848 M9 A-CAMERA, GIVES BROAD AREA COVERAGE, GOOD FOR CRATERING STUDIES DICK. M9 PHOTO INDEX HAS ARRIVED, WILL CONFIRM WHETHER NO M9 HI RES PHOTOS ARE THERE. MORE LATER.



NASA image 673B56, overexposed but slightly different sun angle on City and Face.

An Artist's View

Richard Hoagland, undaunted by Dolphin's reference to Von Daniken, enters the aesthetic judgment of artist Jim Channon on the "Face." (Unfortunately, Channon did not become an active participant.)

[97] *Hoagland* [*Richard*] *21-Feb-84 11:35PM-PST*

The following Entry is submitted by Jim Channon (who will be joining this conference shortly, under his own account).

Jim is a former colonel in the United States Army, assigned to the Pentagon. His current occupation is consultant, mainly in the communications field. He is an accomplished artist, using this talent in furthering communications, particularly in multi-media presentations and corporate affairs.

This, then, is Jim's preliminary analysis of:

THE FACE ON MARS

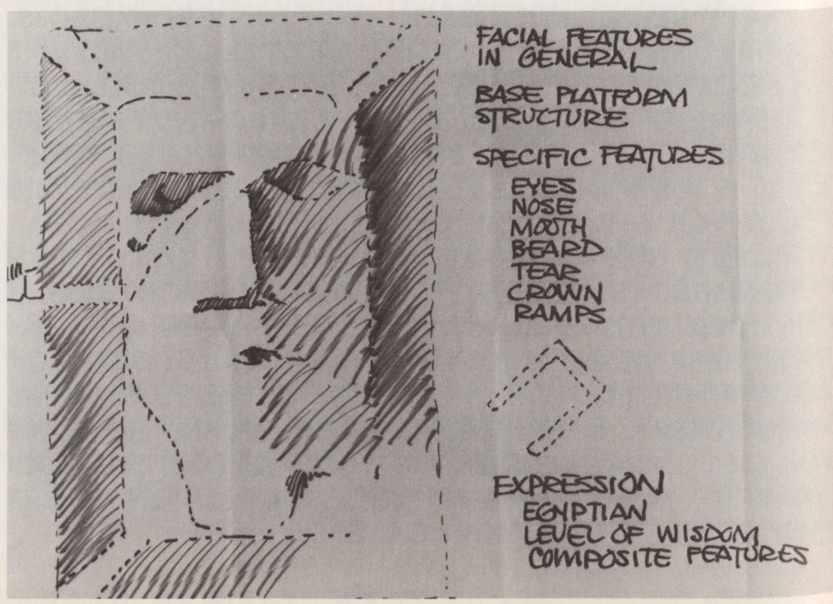
Three elements will be discussed to highlight my findings after a two-day review of photographs provided by Dick Hoagland.

1. Facial Proportions.... Anthropometry
2. The Supporting Structure.... Architectural Symmetry
3. The Expression.... Artistic/Cultural Focus

FACIAL PROPORTIONS

The artist uses classical proportions and relationships when constructing the human face. The eyes, for example, are only barely above a line separating the upper and lower face. The physical anthropologist relates to a set of classic proportions, that relate facial features in predictable ways.

The features on this Face on Mars fall within conventions established by these two disciplines. I find no facial features that seem to violate classical conventions.



Jim Channon's sketch of the features of the Face.

THE SUPPORTING STRUCTURE

The platform supporting The Face has its own set of classical proportions as well. Were the Face not present, we would still see four sets of parallel lines circumscribing four sloped areas of equal size. Having these four equally proportioned sides at right angles to each other creates a symmetrical geometric rectangle. The photo (70A13) with the 30 degree sun angle reveals that they are clearly formed above the surface of the landscape. These support structure features alone suggest a piece of consciously designed architecture.

THE EXPRESSION

For the artist, there is yet a more precise way to judge the authenticity of this form. The expression expected from one powerful enough to be so memorialized by a monument of this scale would not be random. The artistic, cultural, mythic and spiritual considerations behind such a work of art would demand a predictable expression. The expression of The Face on Mars reflects permanence, presence, strength, and similar characteristics in this range of reverence and respect.

The image appears to be a powerful male of about the right age to be a ruler. Working with materials like stone naturally gives an expression of this size a slightly lifeless quality. That is usually a function of the engineering requirements needed to translate an expression to the grand scale seen here.

But, it must be emphasized that the artistic attention required to generate an expression like the one studied is NOT trivial. Very slight changes in the eyes could create an entirely different kind of character. The shape of each feature in a case like this is a matter of precision.

THIS IS NOT JUST ANOTHER FACE

It is the face of a powerful male character with the strength and age known to have created similar artifacts on Earth.

As an artist with anthropological training (I'll enter my BIO when I log in), the evaluation just presented is overwhelming evidence that the structure revealed in the photographs presented to me by Dick Hoagland is a consciously created monument typical of the archeology left to us by our predecessors. I would need much precise evidence at this point to prove the contrary.

Jim Channon
February, 1984

The City and the Honeycomb

One of the common confusions which occurred in the conference was the identification of the "City" with the "honeycomb" structure. Although the "honeycomb" structure was cited by Hoagland as one of the most significant features of the "City" it was not the "City" of this hypothesis. In an electronic conference of this type, this sort of misunderstanding is understandable since the participants rely only on written communication. Misunderstandings or miscommunications are more quickly spotted in

voice and/or visual communication since the participants can read each other's physical and emotional responses immediately and directly. The advantage of computer conferencing is that it allows the participants more time for thoughtful written responses. Interaction rules in a face to face or voice conference require an immediate response.

[98] *Hoagland* [*Richard*] *22-Feb-84 1:59PM-PST*

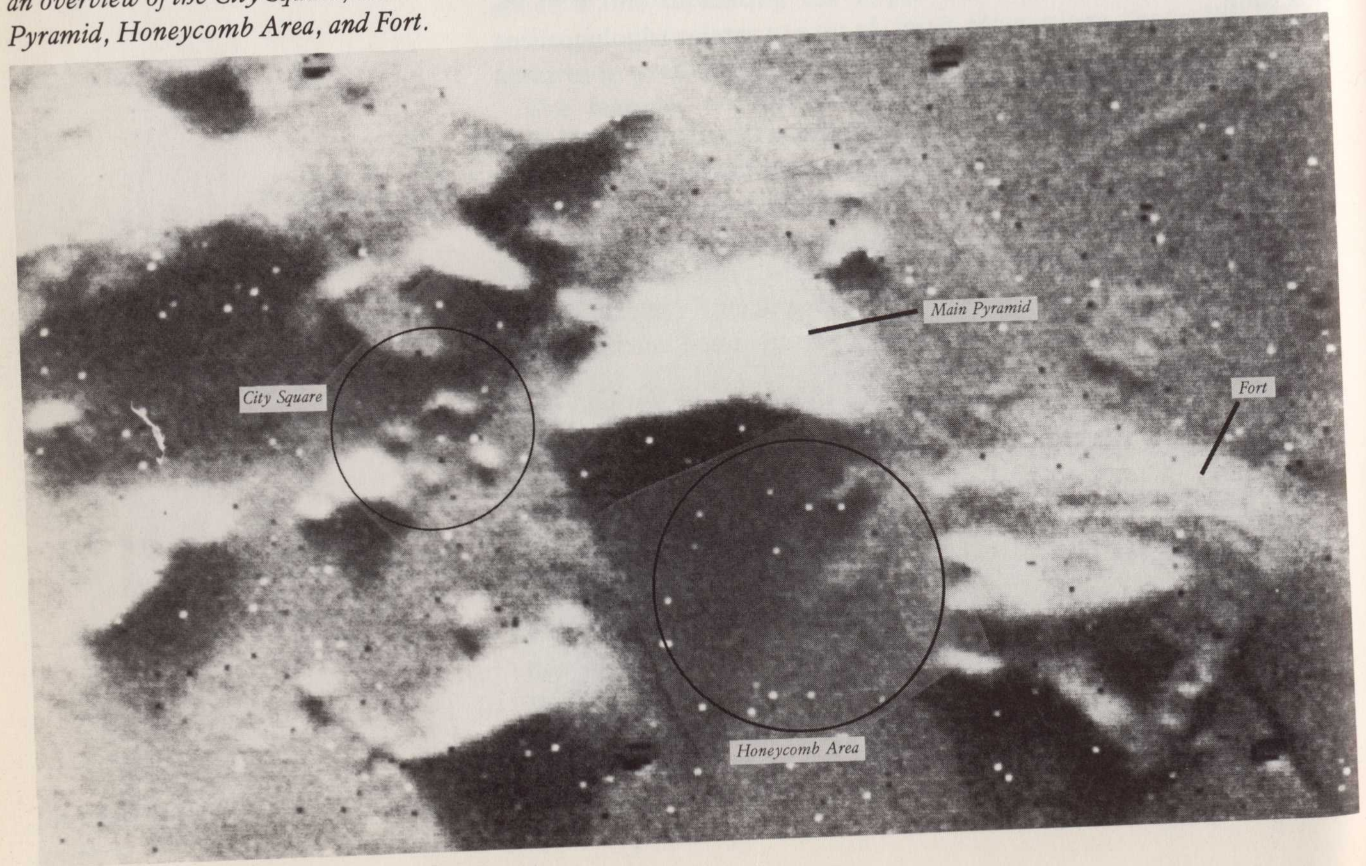
I would like to make a crucial clarification for the record.

Several investigators have commented on the existence or non-existence of "the City" in the past few days. It has come to my attention that we are NOT discussing the same features in this discussion!

"My" City is the collection of objects located about 8 miles south-west of the Face, of which there are at least two truly suspicious and very "artificial looking" representatives: the "Fort" (first SE of the Face), and the "starfish pyramid" located immediately to the south-west of "the Fort." Other strange objects belonging to this "City" include a collection of five small objects located in the heart of the complex, a set of small "domes and cones" scattered non-randomly through this small are, and a definite rectilinear arrangement of a small pyramidal-shaped object west of the "starfish" and a long, bright "structure" arranged at right angles to the southeast "wall" of the starfish-shaped object.

The "City" is thus a marvelously arranged collection of large and small features strung over a rectangle of about 5x8 miles. The entire Complex of these "structures" is oriented such that it affords a nortbeast view of the Face — and of the Summer Solstice circa .5 million years ago.

Blowup of NASA frame 35A72 giving an overview of the City Square, Main Pyramid, Honeycomb Area, and Fort.



The "honeycomb" as a sub-feature of the City is a very small object on this scale. It is a DETAIL — not "the" City! Its existence/non-existence seems to have flared into importance because of its OBVIOUS non-natural appearance. My case for the existence of the City is not based on merely the reality of the "honeycomb," but on the overall mathematical arrangement of the entire 5 x 8 mile Complex of large and small objects in this region of frame 35A72.

To repeat:

The "honeycomb" is NOT "the City." The City is a large rectilinear grouping of large and small objects, comprising some very hard-to-explain members, arranged in such a manner as to resemble in eerie detail similar ceremonial complexes on Earth. Its overall relationship to the Face, in terms of pure geometry, would allow the Solstice Sunrise to be seen from the center of this complex circa half a million years ago (if not earlier). The single, predictive question this relationship demands is this:

Was this unique (in terms of other surface features in the area) geometric relationship designed?

[99] *Dolphin* [*Lambert*] *23-Feb-84 10:34AM-PST*

John Brandenburg has received a print of high-pass, morning shot of the face, # 753A33. He is eager to report to everyone that this photo confirms the symmetry of the face and brings out additional detail on the "dark" side. Negative is in the mail to me and also a digital tape from USGS, Flagstaff. I will distribute prints from negative and from tape ASAP.

I am entering this info at his suggestion. He and I do concur with Hoagland's last entry that there are interesting features in the city area (other than the questionable honeycomb) worthy of comment. These features appear in 70A11 and 35A72 so comments from our team on these features is certainly appropriate. Brandenburg is now searching for areas on Mars with interesting features other than our Cydonia region. The face is certainly more interesting than ever now.

Hoagland greeted John Brandenburg's discovery and examination of 753A33 with unrestrained enthusiasm since the new image confirmed the bilateral symmetry of the face — a characteristic of living organisms on Earth and structures made by humans.

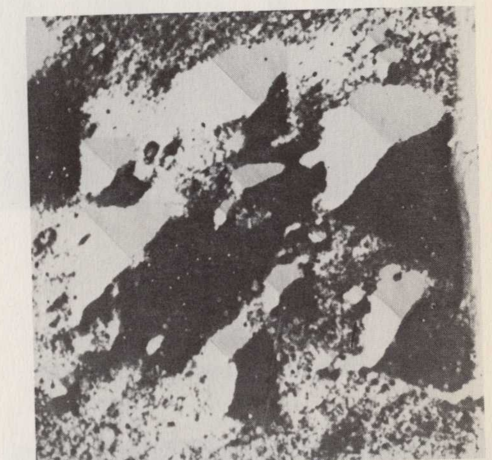
[101] *Hoagland* [*Richard*] *23-Feb-84 5:24PM-PST*

On the new images John turned up:
WHE-E-E-E-E-E-E-!!!! Good show, John.

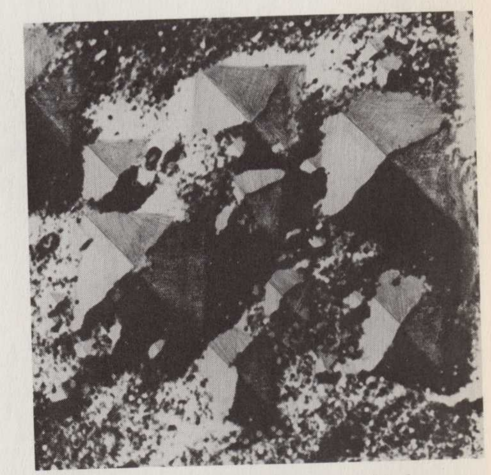
In entry #102, Brandenburg describes the new image he has just received. The picture was taken at mid-morning, with light coming from the southeast. On image 753A33, the face is about 7-8 pixels wide. The face appears to be generally symmetrical in this image. Brandenburg notes that comparison with 70A13 shows no surprising differences. When he examined the image with a magnifying glass he found the right helmet-face boundary to be symmetrical with the left side of the face seen in 70A13 using falsecolor. He promises to get the picture enlarged as quickly as pos-



Channon's reconstruction of the City begins with the unretouched image.



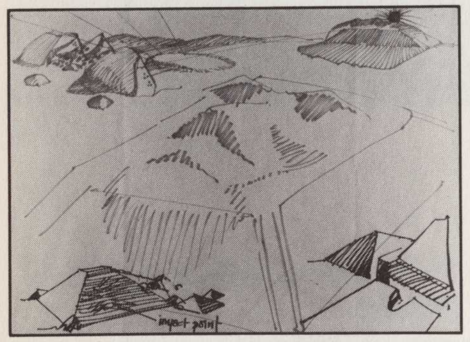
The same image, to which Channon has added partial shading.



The final reconstruction, in which Channon has shaded in the pyramids completely.

from a very desirable angle — including our elusive honeycomb! It should also reveal the destruction of the southeast side of the D&M pyramid in greater detail.

Brandenburg responded at 5:49PM-PST to Hoagland's early morning entry. The sun angle of picture 753A33 was not included in the data block but he estimated it at 45 degrees. The picture was taken at 0933 Marstime. 673B56 was taken at 1725, 35A72 at 1833 and 70A13 at 1650 Marstime. The range for 753A33 was 9300 and for 673B56 was 8400. The frame covers the entire complex under consideration, including the City. A diamond shaped pyramid, the Face and an adjacent object, and another object farther east-southeast of the large pyramid (known as the Citadel). The sides of this diamond have roughly equal sides. There is an object in the center of the diamond at the place in which the lines between the vertices cross. Brandenburg names this object the ''Palace.'' The object next to the head he names the ''Temple.'' The object East-Southeast from the puramid he calls the Citadel. He discovered the pattern because he had to find the head in 753A33 by lining up landmarks. In the process he notices that the head lined up with the pyramid and palace.



Channon's sketch of the mesas.

[107] Brandenburg [John] 24-Feb-84 5:49PM-PST

SUNANGLE FOR 753A33 NOT IN DATA BLOCK, ESTIMATE 45 DEGREES. PHOTO WAS TAKEN AT 0933 MARSTIME WHEREAS 673B56 WAS AT 1725, 35A72 WAS AT 1833 AND 70A13 WAS AT 1650, RANGES FOR 753A33 AND 673B56 ARE 9300 AND 8400 RESPECTIVELY. FRAME COVERS ENTIRE COMPLEX INCLUDING CITY.

PATTERN NOTED! — CITY, LARGE PYRAMID, HEAD & ADJACENT OBJECT, AND OBJECT TO EAST-SOUTHEAST OF LARGE PYRAMID (CITADEL) FORM DIAMOND SHAPE WITH ALMOST EQUAL SIDES. OBJECT IN CENTER, WHERE LINES BETWEEN VERTICES CROSS I DUBB THE "PALACE". OBJECT AT E-SE FROM PYRAMID I WILL CALL CITADEL. I NOTICED THIS PATTERN BECAUSE I HAD TO FIND HEAD IN 753A33 BY LINING UP LANDMARKS. DISCOVERED HEAD WAS IN LINE WITH PYRAMID AND PALACE. SORRY WILL HAVE TO REJOIN LATER.

Brandenburg provides additional important details after a humorous reference to Vince DiPietro, ''POOR VINCE IS TEMPORARILY WITHOUT A MODEM, LIKE A COWBOY WITHOUT A HORSE. WE WILL ALL HOPE HE WILL BACK ON THE AIR SOON.'' The analogy that a participant without a modem is like a cowboy without a horse is very appropriate for computer conferencing.

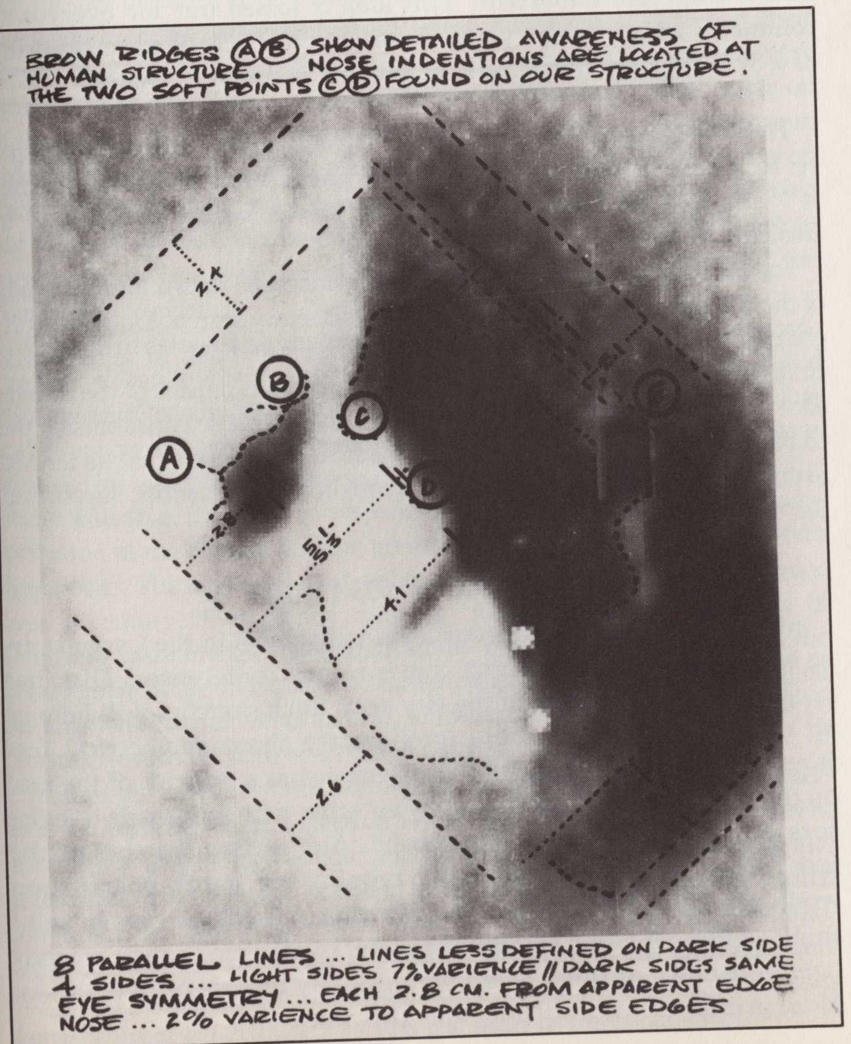
In entry #108, Brandenburg continues his discussion of the pattern at Cydonia. He repeats the description of the pattern in a slightly different format, instructing members of the conference to follow a line between the Head and the D&M Pyramid to cross the object he calls the Palace. A line from the Fort to the Palace will cross another object, the Citadel. Looking at this outline, which is best seen in 35A72, it becomes apparent that the D&M Pyramid, the Fort, the Head, and the Citadel form a parallelogram having almost equal sides. He notes parenthetically that one vertex seems to be half-way between the Head and the nearby object he has called the

Temple. The Palace is at the center of the parallelogram. His reference to ''Brothers'' near the end of the entry reflects the fact that at this point in the conference, only men were actively participating.

[108] Brandenburg [John] 26-Feb-84 11:22PM-PST

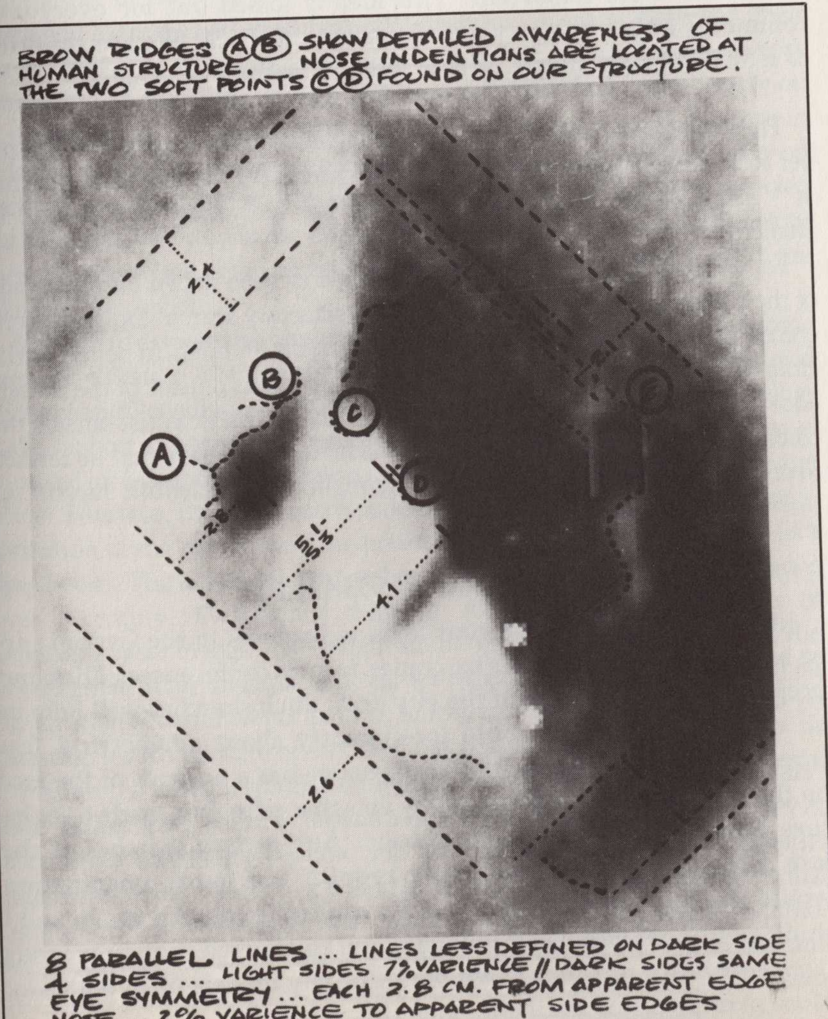
POOR VINCE IS TEMPORARILY WITHOUT A MODEM, LIKE A COWBOY WITHOUT A HORSE. WE WILL ALL HOPE HE WILL BACK ON THE AIR SOON. PATTERN AT CYDONIA — REPEAT: IF YOU GO FROM HEAD TO D&M PYRAMID YOU WILL CROSS AN OBJECT I CALL THE PALACE, IF YOU GO FROM THE FORT TO THE PALACE AND CONTINUE THIS LINE YOU WILL STRIKE AN OBJECT I NOW CALL THE CITADEL. SUDDENLY YOU SEE (BEST IN 35A72) THAT THE D&M PYRAMID THE FORT AND THE HEAD PLUS THE CITADEL FORM A PARALLELOGRAM OF ALMOST EQUAL SIDES (ACTUALLY ONE VERTEX LOOKS TO BE HALF-WAY BETWEEN HEAD AND ADJACENT OBJECT, THE TEMPLE,) SIDES ARE PARALLEL AND PALACE IS AT CENTER, TAKE A LOOK BROTHERS AND RESPOND.

VINCE SAYS GODDARD PHOTOLAB PICTURES NOW DELAYED BY PRIORITY JOB. I AM NOW TRYING TO GET STUFF PURELY THROUGH USGS. GOOD NIGHT, JOHN.



Channon's schematic analysis of the Face based on Hoagland's measurements.

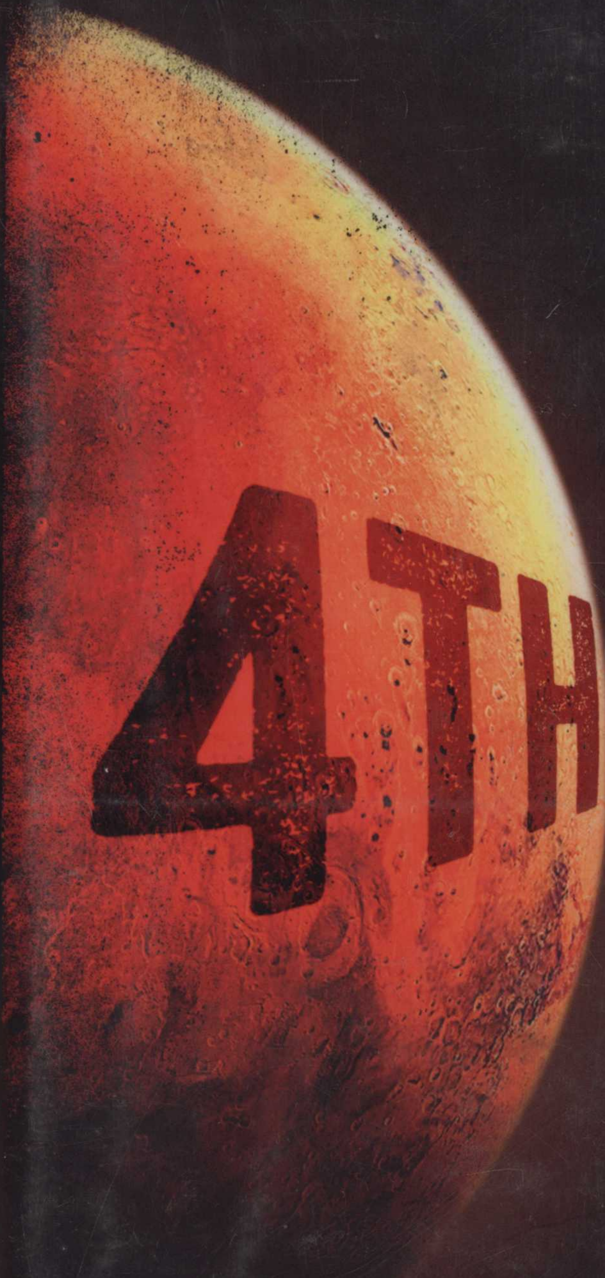
STUFF PURELY THROUGH USGS. GOOD NIGHT, JOHN.



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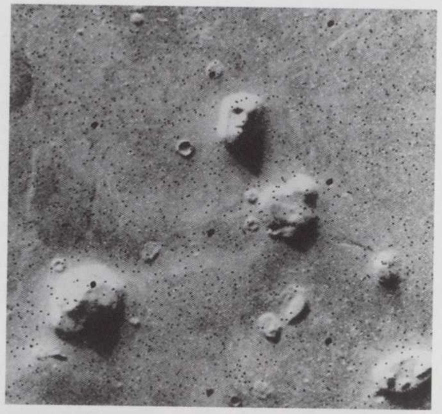
NICKY JENNER



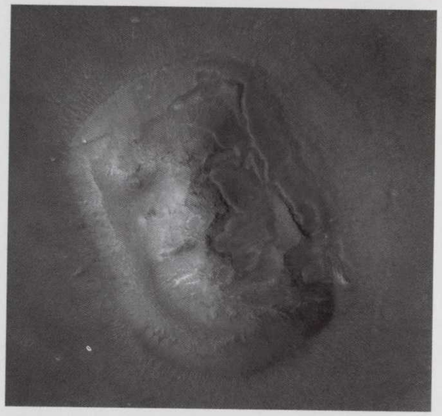
4TH ROCK FROM THE SUN

THE STORY OF MARS

BLOOMSBURY



Left: This 1976 *Viking 1* image shows Mars's Cydonia region, with the 'Face' visible just above centre. This batch of images had a best resolution of 43m (141ft) per pixel. Speckling is due to missing data.



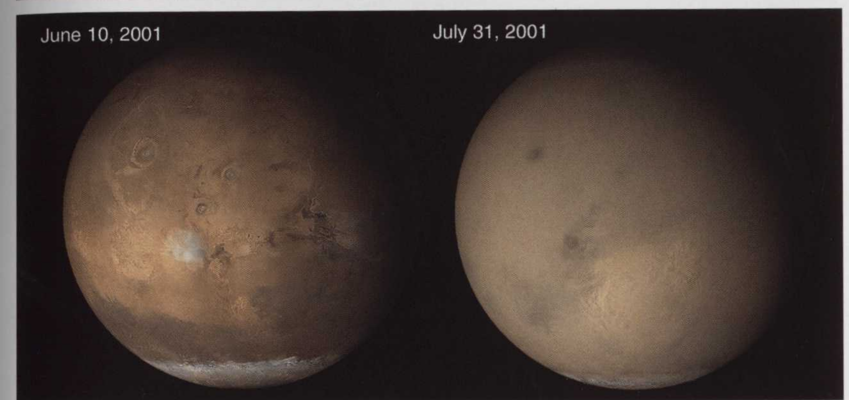
Left: Revisiting the 'Face'. This 2001 *MGS* image has a resolution of around 2m (6.6ft) per pixel, and revealed the 'Face' to be an unremarkable natural landform.

Below: A view of Cydonia (*Mars Express*). The 'Face' is visible in the centre, and the 'City' and 'D&M Pyramid' can be seen to the upper left. The image resolution is approximately 14m (50ft) per pixel.





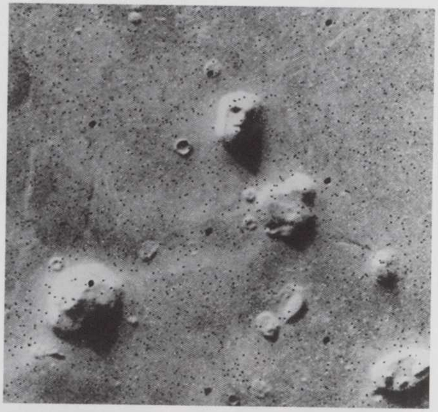
Left: This colour mosaic shows Olympus Mons, the largest volcano on Mars (*Viking 1*, 1978).



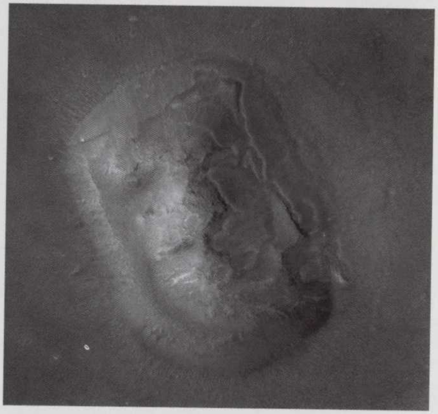
Above: These two *MGS* images show Mars before (left) and during (right) a dust storm in 2001.



Left: *Curiosity* used a new technique when it set wheel on Mars in 2012 – a futuristic sky crane (above) gently lowered the rover (below) to the surface. Artist's impression.



Left: This 1976 *Viking 1* image shows Mars's Cydonia region, with the 'Face' visible just above centre. This batch of images had a best resolution of 43m (141ft) per pixel. Speckling is due to missing data.



Left: Revisiting the 'Face'. This 2001 *MGS* image has a resolution of around 2m (6.6ft) per pixel, and revealed the 'Face' to be an unremarkable natural landform.

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